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Short Communication

On the accuracy of self-reported data for fishing effort estimates – A case study from a polyvalent coastal fishery

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ABSTRACT

The quantification and the analysis of fishing activity is one the most important features in fisheries sciences and ocean management, and fishery-dependent data has always been the main source of information used to that end.

Within the different types of fishery-dependent data, self-reported logbook data provides vast amounts of different information about fishing activities. Despite their enormous importance, the quality and reliability of these data are surprisingly understudied. Yet, the accuracy and consistency of this type of data are sometimes difficult to quantify.

With the purpose of studying how logbook data can be a reliable source for fishing effort quantification, here we estimate and compare, for the Portuguese mainland coastal polyvalent fleet, the fishing effort of each vessel from two types of fishery-dependent data: 1- logbook data and 2- official landing data.

The results showed a difference of 22.7 % between the overall number of fishing trips from both data types. In particular, vessels had a significantly lower number of fishing trips logged on logbook data than the trips estimated from official landing data.

Our findings support the concerns regarding the accuracy of logbook data, especially for estimating fishing effort. As far as effort inference is concerned, we suggest that the estimation of fishing effort from data logged and recorded from a third party, like official landing data, is a more reliable source of information than self-reported data.

1. Introduction

Fishery-dependent data is one of the most vital sources of information used to provide scientific advice for decision making in fisheries management. Important information such as catch trends, stock abundance indexes, by-catch estimates, fishing intensity and distribution can be inferred from different types of fishery-dependent data (Eigaard et al., 2016; Pons et al., 2010; Punt et al., 2000).

The analysis of fishery-dependent data has been the main source of information for the estimation, control and monitoring of fishing effort, an important part of fisheries management (Bordalo-Machado, 2006; Maunder and Punt, 2013). To ensure a sustainable management of fishing activities and of the marine environment, accurate estimates of fishing effort are required as they are vital to, for example, assess stock biomass and variation, study fisher's profitability and market trends (McCluskey and Lewison, 2008; Peterson et al., 2017). Also, the estimation of fishing effort and its distribution allows the development of comprehensive marine spatial plans, establishing effective marine protected areas and the identification of vulnerable habitats and species (Campbell et al., 2014; Campbell, 2004; Halpern et al., 2008; McCauley et al., 2016; Vespe et al., 2016).

There are different methods for collecting fishery data, which can be grouped into three major categories: 1 – data that is self-reported, known as self-report data, which can either be mandatory, like logbook data, or non-mandatory/voluntary, like self-reported data from fishing apps for example, 2- data that is reported and logged by a third party like onboard observers, official port landings and official sales notes and 3- data that is recorded automatically, like Electronic Monitoring (EM) data such as CCTV footage or vessel tracking data.

Self-reported data is an inexpensive way of collecting vast amounts

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of valuable information on fisheries, such as catches, discards, details of fishing activities such as the number of fishing trips, and the start, end and location of fishing events. Among the different self-reporting data collection as self-reporting methods, some are voluntary or non-mandatory, such as through mobile apps or unofficial logbooks. Others are mandatory, including official logbooks and electronic logbooks, which certain vessels and fisheries are legally required to use for recording their activities. The latter has been the most commonly used form of self-reported data. Yet, an important concern intrinsic to this type of data is that its accuracy and consistency inherently depend on those who report it (Granberg and Holmberg, 1991; Klebanoff et al., 2001; Mion et al., 2015; Murray et al., 2013). On the other hand, third-party logged data, even though costly and usually collected in specific infrastructures, like ports or at auctions, or by people that presumably do not have any conflict of interest with the reported data, tend to be less biased, more consistent and usually more accurate (Walsh, 2000; Walsh et al., 2005, 2002).

Developments in collection and analysis of EM data, such as vessel tracking data, like VMS – Vessel Monitoring System or AIS – Automatic Identification System (Galparsoro et al., 2024; Russo et al., 2016, 2011; Tassetti et al., 2022), now allow more accurate estimates of fishing effort (Bastardie et al., 2010; Russo et al., 2016; Sales Henriques et al., 2024; Walsh et al., 2005). Yet, given the novelty and complexity of such approaches, allied with narrower fleet coverage and the difficulty in obtaining some of the vessel tracking data, much of effort estimates still rely on either data reported by third parties, or on logbook data (Fonteneau and Richard, 2003; Sari et al., 2021; Verdoit et al., 2003).

Logbook data has been commonly used to estimate and map fishing effort (Grilli et al., 2021; Raup et al., 2021; Reis-Filho et al., 2021). Yet, given that the accuracy and consistency of logbook data are highly dependent on those who log it, i.e., fishers, (Sampson, 2011) there is a need to understand the accuracy of the information that can be inferred from this type of data (Cotter and Pilling, 2007; Sampson, 2011). There have been studies addressing the accuracy of self-reported fisheries data. For example, Palmer and Wigley (2009) compared the stock distributions when inferred from VMS (Vessel Monitoring System) data compared with logbook data. Results showed that, when fishing activities occurred in different areas, logbook data was less accurate than VMS data to allocate stock. Moreover, logbook data was quite inaccurate when used to allocate stocks of less abundant species. Roman et al. (2011), compared logbook data with validation data from fishers self-sampling programs. One of the findings suggests that the latter is more accurate to estimate fishing effort than logbook data.

This work presents a case study focuses on a Portuguese polyvalent coastal fishing fleet operating throughout its mainland waters. These vessels operate mainly on a daily basis, meaning that they perform fishing trips shorter than 24 h and they use primarily three types of gears, which are nets (gillnets and trammel nets), pots and traps, and longlines. Although a multi-species fishery, the main targeted/caught species are the common octopus (*Octopus vulgaris*), the pouting (*Trisopterus luscus*), the hake (*Merluccius merluccius*), the jack mackerel (*Trachurus trachurus*) and rays (*Rajidea*).

In this case study where we estimate the fishing effort at vessel level, inferred from two different data sources: 1 – logbook data and 2 – landings/sales notes from official fish auctions. We then compare the fishing effort inferred from self-reported data with that from data logged from a third party. We then discuss the implications of estimates of effort from both data sources on managing fishing activities and resources.

2. Rational of the approach

In this approach, we compare the number of fishing trips of each vessel, a commonly used fishing effort unit, that can infer from self-reported fishery-dependent data, i.e., official and mandatory logbooks, and a third-party logged fishery-dependent data, i.e. official landings data. Daily landings/sales notes (from here on referred to as landings data) and landing records from electronic logbook data from polyvalent coastal fishing vessels operating within Portuguese mainland waters from 2014 to 2020 were provided by the Directorate-General for the Natural Resources Safety and Maritime Services (DGRM). Both these datasets contained information regarding the vessel ID (anonymised), the landing dates, landing port, landed species and their amount in kg.

Under the EU's Common Fisheries Policy (CFP), fishing vessels must report their catch and log their fishing activity either on manual or electronic logbooks (EU regulation CE 1224/2009). Moreover, under the Portuguese legislation and during the study period, all catches must be landed and have their first sale at a DOCAPESCA (DL 81/2005) auction. DOCAPESCA is a State-operated company responsible for providing services related to the first sale of seafood in mainland Portugal (http://www.docapesca.pt/).

As far as this work is concerned, the important difference between the two datasets, has to do with the fact that landings data are logged and reported by DOCAPESCA, without the intervention of the skipper, which means that the only requirement for the existence of a landing record regarding a given fishing trip is the vessel to land any catch at the designated and mandatory landing place - DOCAPESCA. On the other hand, logbook data requires the skipper or someone else to manually log and report the information about the fishing activities and catches.

To compare the number of fishing trips of each vessel logged in the two types of fishery-dependent data, we assumed that each landing event, registered with the same landing date on both datasets, represents one fishing trip. Under an ideal scenario, the number of landing records of each vessel, from landing and logbook data, should be identical. Following this assumption, we assume there should be a perfect, or nearly perfect, linearity between the number of fishing trips estimated from both datasets for each vessel when fitting a linear regression model to these variables. In other words, the expected regression line from a fitted linear regression should have a slope of $x = y$ and a R value equal to 1. To do so, we used the "stats" package and "*lm*" function from R software (R Core Team, 2025). The fitted linear regression and number of fishing trips of each vessel from both datasets are displayed in Fig. 1.

Additionally, to check if there are significant differences between the number of fishing trips depending on the data collection method, i.e. landings and logbook data, we tested this hypothesis using the non-parametric Wilcoxon test (normality of the number of fishing trips not met) (Wilcoxon, 1945).

Due to exemptions within EU CFP control regulations regarding logging and reporting logbook data, special care was taken before comparing the number of fishing trips logged based on the two data types. According to EU regulation CE 1224/2009 article 14th, only catches with more than 50 kg of each species are required to be logged in logbooks. This means that catches less than 50 kg may not be logged in logbooks. Due to this exemption, in order to avoid uneven numbers of landing records between logbook data and landing data, only landing events with at least one record with more than 50 kg of any given species were considered in both datasets.

Under article 15th from the same regulation concerning the logging and reporting of logbook data, all fishing vessels with a LOA equal or above 12 m are required to log and report their activity through electronic logbooks. However, it is also stated in paragraph 4 that Member States may exempt vessels under 15 m LOA (Length Over All) from logging and reporting logbook data if a vessel only operates within national waters and who's fishing trips do not last longer than 24 h. Given the characteristics of the Portuguese polyvalent coastal fishing fleet, that carry out daily trips within Portuguese waters, some vessels with LOA under 15 m could be exempt from logging and reporting logbook data. Therefore, to avoid having more recorded landing events within landing data than from logbook data, only data from vessels with LOA above 15 m was analysed.

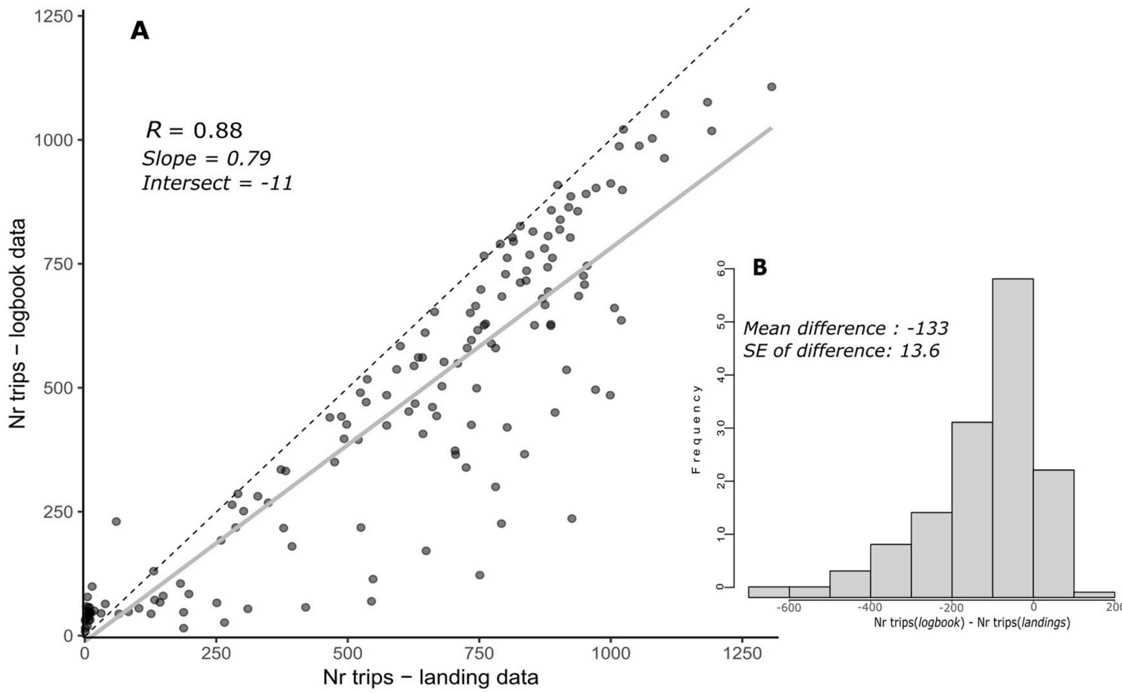

Fig. 1. A - Number of fishing trips inferred from landing data and logbook data, during the period of 2014–2020, for each of the 157 analysed vessels. Only one vessel showed the same number of fishing trips from both datasets, whereas 132 vessels had lower numbers of fishing trips logged on logbooks than those registered in landings data. The remaining 24 vessels had more landing events logged on logbook data than on landing data. The fitted linear regression model (light grey line) the R value, slope and intersection are shown. To compare the slope of the linear regression model with the expected slope = 1, a x = y line (dashed black line) is also displayed; B – Histogram showing the distribution of the difference of fishing trips estimated from both datasets for each of the analysed vessels. The mean difference and standard error are also displayed.

3. Results

The present work analysed logbook and landing data from 157 polyvalent coastal fishing vessels over a period of seven years (2014–2020). The number of fishing trips inferred from both types of fishery dependent data differed significantly ($p < 0.05$, Wilcox test). Overall, we could detect 90873 fishing trips from landings data, whereas 70743 fishing trips were identified from logbook data, corresponding to 22.7 % fewer fishing trips detected from the self-reported data (Fig. 1).

As expected from the results above, the majority of vessels (132) had more landing records on landings data than on logbook data. On average, and at vessel level, we identified more 133 fishing trips on landings data than on logbook data. On the other hand, 24 vessels had more landing records on logbook data compared to landing data, and only one vessel showed the same number of landing records in both datasets (Fig. 1A). The fitted linear regression model also indicates that a lower number of fishing trips was inferred from logbook data (slope < 1) and the $R = 0.88$ indicates, as expected, a strong, although not perfect, correlation between the number of fishing trips identified in both datasets.

The distribution of the difference of number of fishing trips, at vessel level, detected on both datasets showed a skewed pattern (Fig. 1B). It ranged from 633 less fishing trips logged on logbooks than on landings records to 170 more fishing trips detected on logbooks compared to those detected on landings data.

4. Discussion and conclusions

Concerns about the quality of logbook data is not new and there have been different studies addressing this issue with different conclusions. For example, Bishop *et al.*, (2008) found that logbook data, when used to standardize catch rates, was systematically incomplete and sometimes unreliable. On the other hand, Mion et al. (2015) compared e-logbook data with observer's data and concluded that self-reported logbook data agreed with observer's data and that it allowed the description of the spatiotemporal patterns of target species. Emery et al. (2019a) also found congruence between Electronic Monitoring (EM) and logbook data on catches. However, this congruence differed between retained and discarded catches. Sampson (2011) analysed reported fishing locations and catches with official landing records from Oregon trawlers. He concluded that logbook data on depth and location was sometimes inconsistent and that the logbook records on retained catches were inaccurate relative to the official landing data. Furthermore, the study also concluded that the factor vessel, among other variables like year and quarter, was the main explanatory variable explaining the variance of the accuracy and consistency of the logbook data.

In the present work, we observed a significant difference between the effort estimated from both types of data. In an ideal scenario, we would expect that the number of fishing trips inferred from both datasets to be nearly identical and therefore, the R from the regression model to be closer to 1. Moreover, the R^2 value of 0.77 indicates that there is variation in the number of landing records in both datasets, throughout the analysed fishing vessels. In other words, some vessels had a lower discrepancy in the number of landing records in both datasets, whereas other vessels had a quite evident discrepancy.

These results are not surprising as logbook data requires that fishers manually log, and in a correct way, the information about the fishing trips. This means that the existence of such data is dependent on many variables, such as the willingness, motivation and consistency in logging and reporting logbook data in a precise manner; the computer literacy of fishers to operate electronic logbooks; and the correct working conditions, such as internet connection of the computer with the electronic logbook or software related problems that may fail to transmit the logged information by the skippers. If one of these variables fails, the most likely scenario is the absence of logbook data for a given fishing trip. Moreover, if the vessel is targeting a species subject to quotas or catch limits, fishers may also avoid reporting the catch of those species to avoid reaching the official catch limit. On the other hand, for the existence of landing records in official landing data, the only requirement dependent on fishers, is that fishers land their catch where they legally must, which is a rather straight forward process, as the landings of catches happens when vessels arrive at the fishing port.

Considering the arguments stated above, the fact that 24 fishing vessels had more records on logbook data than on landings data might be unexpected. Although we cannot prove why these vessels had more landing records on logbook data than on landings data, the geographical location where these vessels usually land their catch might gives us a clue. These vessel all operate in neighbouring regions to Spain. So, we can hypothesize that these vessels may land their catch in Spanish ports, which will result in the absence of official landing records in the analysed official landings data, whilst the logbook records, that are always transmitted to the vessels' flag country, are still existent for a given fishing trip that landed their catch in Spain.

Regarding the quantification of the fishing effort, our results support the concerns about logbook data quality. Since fishing effort is an important aspect when managing fisheries and the ocean space (Demirel et al., 2023; Orofino et al., 2023; Trudeau et al., 2021), the underestimation of this activity might bring erroneous and undesirable conclusions that might jeopardize the design and implementation of management plans (Hiddink et al., 2023; Omori et al., 2016; Sondita, 2020).

Indeed, the fact that there are many probable reasons for the absence of logbook data for a given fishing trip makes logbooks, as far as effort quantification is concerned, a less reliable source of information. Moreover, the reporting exemptions allowed by the EU CFP regulation, such as for vessels between 12 and 15 m LOA that only operate within national waters and for no longer than 24 consecutive hours is also a relevant limitation of logbooks as a source of information. Another limitation from logbooks, although not directly related with effort estimates, relates with the fact that, according with the same regulation, only catches with more than 50 kg of each species are mandatory to be logged in logbooks. The logging exemption for catches below 50 kg of each species may result in the underestimation of catches of some species or for particular fisheries if logbook data is the only source of information. However, if catch report is mandatory for all catches, as it happens in other regions around the world, regardless of how much of each species is caught, logbook data might be a more reliable source of information to estimate catches and stock abundances. Which means that the usage and conclusions drawn from logbooks alone should be considered cautiously and to take in considerations the reporting requirements and exemptions.

On the other hand, using official landing data, collected from an official entity at an official landing site, for which fishers are not responsible neither for the logging nor the reporting of the data, seems a more reliable source of information to estimate the fishing effort. Having designated personnel and/or infrastructures responsible for the collection of fishery data, such as onboard observers and, in the Portuguese case for example, a state operated company responsible for the collection of landing data seems a more reliable source of information. Indeed, these data sources are more costly than self-reporting data, which is their major disadvantage, and we recognize that it is not feasible to have onboard observers in every vessel. The establishment of entities or infrastructures that can be responsible for data collection is not an easy task either. Another important drawback from this form of data collection is its temporal and spatial coarse resolution. Indeed, if logbook data is correctly and accurately logged, this data collection method can provide very important information that official landings data cannot.

However, thanks to recent developments in data collection, storage and analysis of EM data, other tools can be used to improve the collection of and make inferences from fishery dependent data. For example, vessel tracking data can be used to estimate fishing effort with much higher resolution (Eigaard et al., 2016; James et al., 2018; Jennings and Lee, 2012; Sales Henriques et al., 2024). Electronic monitoring with CCTV cameras has already been used to estimate discards and interactions and accidental catches of protected species (Emery et al., 2019a), which until now could only be reliably collected through onboard observers. Moreover, the presence of EM onboard fishing vessels has shown to improve the quality of logbook recordings by the skippers (Emery et al., 2019b).

Indeed, each type of fishery-dependent data poses its advantages and disadvantages. EM despite its already acknowledged potential, has its disadvantages, such as its novelty, which makes it still far from being broadly implemented throughout fishing fleets. Furthermore, the large volumes of data it generates and the complexity in their analysis are some of the challenges that will need to be addressed in the near future. Moreover, a well-trained, experienced and motivated observer or fisher in logging fishery dependent data will always be a very important data source with a wide range of capabilities that an automatic logging device will hardly be able to compete with. This is why we argue that in order to improve the quality and quantity of information used in fisheries management, the approach to follow is to 1- acknowledge the advantages and disadvantages of each type of fishery dependent data and 2 - to combine these different types of data, as has already been done (Bastardie et al., 2010; Russo et al., 2018, 2016; Sales Henriques et al., 2024), to make more reliable inferences that will improve the management of fishing activities and of the marine environment.

CRediT authorship contribution statement

Karim Erzini: Writing – review & editing, Supervision, Funding acquisition. **Jorge M.S. Gonçalves:** Writing – review & editing, Supervision, Funding acquisition. **Nuno Sales Henriques:** Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Tommaso Russo:** Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

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